

WATER

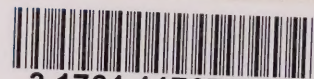
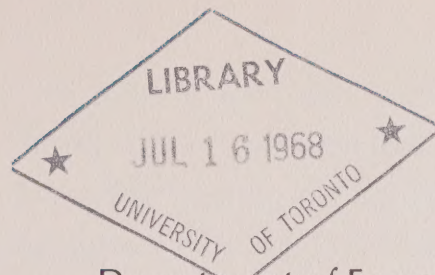
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—careers for university graduates

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Department of Energy, Mines and Resources, Ottawa, Canada



If you are interested in a challenging career in an exciting new field, you will find it in that vitally important and rapidly developing segment of the Canadian economy—water.

The federal government, through the Department of Energy, Mines and Resources, offers exciting opportunities in work where the new graduate with initiative, enthusiasm, and capacity to learn will have wide scope for the development of his ability and for advancement.

The Department's Water Group is responsible for engineering and scientific research studies of Canada's coastal and inland waters and the formulation of federal policies on water. It has openings for new graduates in

Administration	Geography	Limnology	Physics
Chemistry	Geology	Mathematics	Political Science
Economics	History	Meteorology	Resource Management
Engineering	Law	Oceanography	Sociology

Opportunities

The new graduate may become a member of a scientific research group or an engineering team, working to expand existing knowledge of water, its composition, treatment, behavior, uses, control and management. He will be encouraged to develop his individual capabilities and to exploit his potential for research. He will have ample opportunity to present his work to the scientific community through publications and through participation in scientific meetings.

Or the new graduate may become a member of a policy advisory or planning group and participate, on interdisciplinary teams, in policy studies or in complex investigations leading to the preparation of comprehensive basin and regional plans for water developments.

Department of Energy,
Mines and Resources
Hon. Jean-Luc Pepin, Minister
Dr. C. M. Isbister, Deputy Minister

ROGER DUHAMEL, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, 1968

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water in Canada

Inland waters

Canada is one of the most favored countries in the world in its wealth of fresh water—man's most precious resource. Vital to life itself, fresh water is the indispensable element in agriculture, forestry, fishing, hydroelectric power, recreation, waste disposal and navigation.

In the past, a small population and an infant economy made few demands on Canada's wealth of fresh water. But almost overnight, a fast-moving technological society has not only placed tremendous pressures on our supplies of fresh water, but has also created serious problems in the pollution of our lakes and streams.

Ocean waters

Canada has a major interest in the sea, bounded as it is on the north, east and west by different oceans. It possesses one of the world's longest coastlines and some of its greatest expanses of continental shelves. World attention is being focused more and more on the sea as a potential source of much needed additional supplies of food and of mineral wealth, particularly of oil. The sea, too, is a vital factor in the defence of Canada.

the water group department of energy, mines and resources

The Water Group advises on federal water policies, undertakes joint programs with the provinces for water conservation and development, coordinates the work of federal agencies in water resource use and management and water pollution, carries out broad programs of hydrometric and hydrographic surveys, and conducts oceanographic and limnological research, including research on the relationship of water and renewable resources.

The Group is composed of three branches: the formerly established Marine Sciences Branch and two new branches, the Inland Waters Branch and the Policy and Planning Branch.

The Group has a fleet of hydrographic and oceanographic vessels on the Atlantic and Pacific coasts. Its major oceanographic vessel, the Canadian Scientific Ship *Hudson*, is considered to be the top oceanographic vessel of its kind in the world. Three new vessels were commissioned in 1967.

To carry out its new program of fresh-water resource studies and investigations, the Group has modern survey ships under charter pending the construction of new research vessels, especially built and equipped for work on the Great Lakes.

Marine Sciences Branch

The Marine Sciences Branch is the federal agency responsible for Canada's effort in defence oceanography, arctic oceanography, the study of the country's continental shelf and deep-ocean studies. The Branch is composed of the Canadian Hydrographic Service, the Oceanographic Research Division, the Ship Division and the Canadian Oceanographic Data Centre.

At present, Branch activities in oceanography, geophysics, chemistry and geology are centred at the Bedford Institute of Oceanography at Dartmouth, N.S., and are carried out in Atlantic and sub-Arctic waters. The Institute accommodates 300 professional and supporting staff. The Branch is expanding laboratory and office accommodation and supporting facilities at the Institute. It also plans the establishment of an Institute on the Pacific Coast similar to the Bedford Institute of Oceanography.

Inland Waters Branch

The Inland Waters Branch is the national agency for the scientific study of Canada's inland waters. It is responsible for all survey and investigatory programs on these waters by means of applied and basic research and a whole range of engineering studies and investigations. The Branch is also responsible for investigations in the major fields of water pollution, water conservation and water utilization. It works cooperatively with other federal departments, provincial agencies and educational institutions which are conducting programs in water study.

The Branch is composed of five divisions: the Water Survey of Canada, and the Engineering, Hydrological Sciences, Water Quality and Great Lakes divisions. The first four are located in Ottawa while the fifth, the Great Lakes Division, is in Burlington, at the western end of Lake Ontario. Here the Branch is building the Canada Centre for Inland Waters, a major research establishment for the study of the Great Lakes and other inland waters. The Water Quality Division will be moved to the new centre upon completion of construction.

Policy and Planning Branch

The Policy and Planning Branch provides advisory services on water and related resource policies and programs. It develops and maintains coordination within the federal government and cooperation with the provinces in the formulation and implementation of such policies and programs. It conducts basic and applied economic and interdisciplinary research. It participates in basin and regional resource investigations undertaken through interdepartmental arrangements and through federal-provincial and international agreements. It negotiates and administers joint research planning and development programs in the water field.

The Branch comprises the Policy, Coordination and Administration Group, the Planning Division and the Resources Research Centre.

The physical sciences

Graduates in physics, chemistry, geology, geophysics and mathematics are needed in the Marine Sciences and Inland Waters branches to study and investigate Canada's coastal waters (oceanographers) and Canada's inland waters (limnologists).

Physical oceanographers study the physical state of the sea, including its variations in both time and space, to determine the physical processes occurring in the ocean and to predict aspects of the sea's behavior. They are primarily interested in measuring the physical parameters of the ocean, in describing the distribution and variability of these parameters and designing models leading to the prediction of the character of water masses and motion in the ocean.

Chemical oceanographers apply chemical techniques, laws and principles to the study of the ocean. Their work is devoted to the accurate description of the chemical nature of the seas, to the investigation of the processes that produce and alter the chemical characteristics of the ocean and the effect of the chemical composition of sea water on the biological, geological and physical processes of the marine environment.

Marine geologists and geophysicists study the geology of the sea floor and investigate the structure of the earth's crust beneath the oceanic depressions. They employ the methods of geology and geophysics to study the material

and form of the sea floor and the underlying structure, and relate these observations to the processes that form the ocean basins.

Physical limnologists maintain continuous surveys and surveillance of the physical environments of lakes, study the dynamics of the "motions" both horizontal and vertical, turbulent diffusion, water levels, seiches, wind, tides, energy exchanges and those other physical processes governing the movement and distribution of pollutants.

Chemical limnologists carry out studies of lake chemistry to determine the concentrations, behavior and balance of chemical constituents in the lakes. With this information, load tolerance can be set on the basis of maintaining an acceptable water quality in the lake itself rather than by arbitrarily assigning tolerance levels to municipal or industrial waste discharges.

Limnogeologists conduct geological, geochemical and biological-micropalaeontological research aimed at describing and understanding the sedimentological regime of the lakes and establishing its bearing on pollution.

Chemists and physicists work in various areas. They supplement in the laboratory the work done by oceanographers and limnologists in the field. They carry out basic and applied research on the properties, constitution, structure, bonding and complexing of water, ice, and vapor and their relationship to the mineral, organic, inorganic, biochem-

ical and other substances with which water, ice and vapor come into contact. They carry out investigations concerning water pollution, pollution abatement and treatment of water for specific uses.

Geographers (see also Geographers under Social Sciences) study the nature and location of the country's basic resources and the topography and climate of the regions in which they occur, as factors in the economics of project development. They conduct glaciological, fluvioglacial, sedimentological and related geomorphological studies.

Hydrogeologists study the dynamic relationships between water and its geological environment. The investigations are aimed at obtaining a complete description of the mechanisms governing groundwater movement to permit the assessment of the availability of water from this source in relation to the nation's needs. The programs are carried out by combining laboratory modeling techniques with field studies to determine the factors that influence groundwater flow.

Engineering

Graduates in engineering are needed to carry out a wide range of studies and investigations on Canada's inland waters. The Water Group conducts comprehensive surveys of existing and projected uses of water in Canada, including the purposes for which water is used and the quantities involved.

Hydraulic engineers carry out studies and surveys of water levels, stream flow, sediment transport and shore erosion, and may be engaged in water resource development programs under the terms of federal-provincial and international agreements.

Structural engineers prepare, or review, the designs of proposed hydraulic structures for controlling the flow of water in rivers and lakes.

Hydrologists are concerned with the distribution and circulation of water. By analyzing stream flow and meteorological data, they are able to determine river-flow characteristics and forecast future patterns of behavior. They design, develop, calibrate and test scientific equipment to meet the special requirements of the science.

Sanitary engineers are required for studies of pollution and methods of control and in the field of water quality.

Social sciences

Graduates in economics, geography, resource management, mathematics, history and other disciplines have a significant role to play in the Water Group, especially in the Policy and Planning Branch.

Economists are employed in several areas encompassing policy formulation, basic and applied research and resource planning. The work ranges from the economic analysis of resource problems through to participation on interdepartmental and federal-provincial committees, or task forces, set up to

negotiate and coordinate basin and regional resource investigations. It includes, for example, studies to identify and evaluate regional and national trends in water uses and to forecast future water requirements, studies of conflicts between water uses, studies of the implication of interregional transfers of water, and studies to evaluate development alternatives, involving the use of benefit-cost and other techniques.

Economic geographers are also employed in the above areas. In addition, economic geographers play an important role in basin and regional planning investigations. They prepare economic base studies and engage in basic and applied research on resource inventories, transportation, industrial and urban location and regional development.

Mathematicians and statisticians are engaged in the design and application of "systems" methodologies. This includes, for example, the development and implementation of systems for the periodic collection, compilation and processing of economic data related to the use of resources; studies of the application of operations research and systems analyses techniques to highly complex problems of resource planning and management, and the development of hydroeconomic models of river basins and regions.

Historians carry out broad studies of the history of Canadian resource development — the policies, programs and institutions that have shaped the current pattern of resource management in

Canada. Comparative analysis with other countries is an important part of this work.

Political scientists study mainly the jurisdictional and institutional aspects of resource management in Canada, the constraints on management imposed by jurisdictional and institutional factors, and alternative arrangements—federal, federal-provincial and international—compatible with the Canadian constitution, history and experience.

In today's increasingly complex society, very few resource problems can be resolved within the framework of any one discipline. Therefore, the Water Group provides professionals in the above and other fields with a unique opportunity to pursue their work within an interdisciplinary milieu and framework.

The Water Group also employs a number of what might best be described as **resource managers**. Usually at a fairly senior level, they personally enjoy an academic background or experience which encompasses, or bridges, two or more of the physical and social sciences. They may be engaged in the direction or coordination of interdisciplinary research 1) participating in task forces, committees or boards set up to negotiate, coordinate and undertake investigations leading to the preparation of comprehensive plans for basin and regional resource development, 2) directing broad and complex policy investigations, or 3) managing joint, interjurisdictional programs of research, planning and development.

training

The Department provides specialized training in a number of fields associated with the work of the Water Group.

Training in the various disciplines of oceanography is given at three universities to well qualified university graduates with an honors degree in one of the physical or natural sciences, including mathematics. The three universities are the Institute of Oceanography, University of British Columbia, Vancouver, B.C., the Institute of Oceanography, Dalhousie University, Halifax, N.S., and the Marine Sciences Centre, McGill University, Montreal, Que. The Great Lakes Institute of the University of Toronto offers a diploma course in limnology to graduates in science and engineering.

Students interested in pursuing a career in marine research should contact the head of their department for advice, or write directly to one of the above-named marine institutes.

Financial assistance for graduate studies is available where these studies relate to the programs of the Water Group.

Postdoctorate fellowships, tenable in the Water Group, are available through cooperative arrangements with the National Research Council.

salaries

Salaries offered to new university graduates at the Bachelor, Master and Ph.D. levels are normally competitive with those offered by other Canadian employers.

benefits

The benefits are many and varied. They include ten statutory holidays a year plus three weeks' vacation; fifteen days of sick leave annually, which, if unused, accumulates from year to year; enrolment in one of the most comprehensive superannuation plans in Canada, under which a pension can be as much as seventy per cent of the average salary of the six-year period of highest earnings; low-cost term insurance and, if desired, enrolment in an excellent surgical-medical plan.

how to apply

Recruiting teams, coordinated by the Public Service Commission, visit Canadian universities from coast to coast each year during November, December and January. Details of interview dates and locations, and application forms are available from your Placement Officer. Bulletin board announcements of these dates are also displayed on the campus in late fall.

Further information about positions available in the Department of Energy, Mines and Resources may be obtained from: Mr. R. B. Code, Director, Personnel and Organization, Department of Energy, Mines and Resources, 588 Booth Street, Ottawa 4, Ontario.

summer employment

The government service begins its search for prospective employees long before they graduate. Each summer it employs students to work in its departments. In most instances, the students receive travel assistance.

For further information and application forms, contact your University Placement Office.